

## Are There Limits to Growth?

### A Dynamic Systems View of Humanity and Economic Growth

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**G***rowth* is the adsorption of resources into the structure of an organized system, made possible by a dissipation of energy.

Growth requires *energy* and available *resources* (matter). Growth can only occur within some form of *energy gradient* where energy in a more ‘concentrated’ form is available to be dissipated into a less concentrated form. The process of growth controls the dissipation of energy so that some of the energy is captured within the system as *organization*, and the remainder is dissipated to the outside environment.

*Simple growth* adds to the scale of existing components within the system, while *complex growth* adds new components with new interrelationships within the system.

Limits to growth are always contextual. Simple growth of a system is always limited by available resources and available energy. If the resource pool is effectively limited, and/or if available energy is effectively limited, then simple growth is effectively limited.

Complex growth is much more, well, complex! Complex growth introduces the factor of variable efficiency. By introducing new components and interrelationships, complex growth can change the *efficiency* by which available energy and resources are utilized for future growth. If a greater percentage of a constant flow of energy can be diverted into organization, or if less external matter is required for further growth, then the limits to growth are extended.

Complex growth can also change the dynamics of the system in such a way that previously un-utilized energy gradients or previously unused material resources can be utilized. Complex growth can also find ways to neutralize inhibiting factors, such as waste products harmful to the system.

Human society on the planet Earth is an example of a dynamic system exhibiting both simple and complex growth. Simple growth occurs as the population of humans increases: our species has grown from a few million individuals to more than six thousand million individuals in the past 10,000 years. Along the way, we have blown through numerous limits to simple growth imposed by energy and resource limits at any given point on that timeline. We did so by changing the way we “played the game”. We discovered new sources of energy, and developed new tools and social structures for utilizing previously untapped resources.

Today, we are at a “crisis point”, a point where our complex dynamic system is unstable due to constraints on energy and resources, and due to rising inhibiting factors such as

pollution, ecosystem damage, and biodiversity loss. Accelerated by fossil fuels, human growth has slammed at high velocity against limits to growth. What now?

1) Stop Growing in Scale

Human population soared as fossil fuel energy dramatically increased both food supply and the opportunity for productive economic work. Every human, however, is a biological system that consumes resources and generates waste. Under the current limits to growth, we have already exceeded the sustainable carrying capacity of the planet.

2) Improve Efficiency

We need to channel our intelligence and productive effort away from “more of the same” and into “more from less”. We need to look everywhere for energy and resource “leaks”, and seek to use energy and resources more efficiently. Better insulation, new materials, new design, new methods, recycling of resources; greater efficiency lets us do more with less energy and fewer resources, and mitigates inhibiting factors.

3) Develop Alternative Energy Sources

As we have seen through our history, energy is the key to development. While we must focus heavily on energy efficiency, we must also put substantial intelligence and productivity into developing new energy sources to replace fossil fuels.

4) Reduce Conflict

A few hundred years ago nations were effectively independent societies having only limited interaction within a world of fairly abundant untapped resources. In that circumstance, developed nations were often in conflict over “ownership” of less developed regions of the world. Today, it is clear that we are a single, interconnected, global system of nations. Conflict among nations is destructive and costly, and reduces efficiency and productivity.

5) Focus on Development

Conflict is inevitable where certain populations enjoy a much higher level of economic development than others. Since no population wants to go backwards, it makes sense to focus on the development of under-developed economies. Since this is growth, items 1-3 above and item 6 below are essential in the process.

6) Increase the Intelligence of the System

Intelligence is the ability to direct resources and energy into new system structures that increase sustainability of the system. All life has intelligence. Humans have intelligence, and somewhat separately, human society has intelligence embodied into its institutions and cultures. Human society has grown so extensively in large measure because of its ability to capture and institutionalize the knowledge of transient human individuals. The leadership of human individuals, however, remains essential to this process. As individuals, we must work to improve the mechanisms by which intelligence is acquired and distributed throughout global humanity. With greater distributed intelligence comes greater distributed development, comes lessened conflict, comes new innovation, comes new horizons of growth.

Growth is good, so long as growth increases the sustainable complexity of the system. Now is a time of crisis. Now is a time of opportunity. There is a new “land of promise” out there, but there is also a desert to cross. Wise leaders lead us into lean times.